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# State of North Carolina
# Utilities Commission

Post Office Box 29510
Raleigh, N. C. 27626-0510



May 21, 1998

Honorable Magalie Roman Salas
Secretary
Office of the Secretary
Federal Communications Commission
1919 M Street, N.W.
Room 222
Washington, D.C. 20554



Re: The North Carolina Utilities Commission's Forward-Looking Economic Cost Studies filed in compliance with CC Docket No. 97-160 and 96-45

Dear Secretary Salas:

With respect to the above subject matter, enclosed are the required WordPerfect documents and Excel spreadsheets representing the forward-looking economic cost (FLEC) studies proposed by the North Carolina Utilities Commission. These documents are presented as required in the FCC's Public Notice DA 98-217 released February 27, 1998.

The following ten, 3.5", read-only diskettes are included:

1. <u>FLEC Study for BellSouth Telecommunications, Inc. (BellSouth):</u>

   Disk 1 of 2 contains the input and output files of the study in Excel and Comma Separated Variable (CSV), as included in the following files:

   (a) ncinput.xls
   (b) ncgrid~1.xls
   (c) ncrev2~1.csv
   (d) ncrev2.ini
   (e) lines.csv

430 North Salisbury Street • Raleigh, North Carolina 27603
Telephone No: (919) 733-4249
Facsimile No: (919) 733-7300

Disk 2 of 2 contains the text document in WordPerfect 6.1 under the file name "textbell.wpd".

2. FLEC Study for Carolina Telephone and Telegraph Company (Carolina)

Disk 1 of 2 contains the output reports and the inputs of the study in Excel and CSV, as included in the following files:

(a) cttout.xls
(b) manual.csv

Disk 2 of 2 contains the inputs files and access lines by wire center and the text document in WordPerfect 6.1, as included in the following files:

(a) input.xls
(b) cttlines.csv
(c) textc&c.wpd

3. FLEC Study for Central Telephone Company (Central):

Disk 1 of 2 contains the output reports and the inputs of the study in Excel and CSV, as included in the following files:

(a) centout.xls
(b) manual.csv

Disk 2 of 2 contains the inputs files and access lines by wire center and the text document in WordPerfect 6.1, as included in the following files:

(a) input.xls
(b) centline.csv
(c) textc&c.wpd

4. FLEC Study for GTE South, Incorporated (GTE):

Disk 1 of 3 contains the input files of the study in Excel and CSV, as included in the following files:

(a) inputnc.xls
(b) ncgte.csv
(c) nclines.csv

Disk 2 of 3 contains the output files of the study in Excel, as included in the following file:

(a) reportnc.xls

Disk 3 of 3 contains the text document file in WordPerfect 6.1 under the file name "textgte.wpd".

BellSouth, Carolina/Central, and GTE learned of a minor error contained in the Sprint version of the previously filed BCPM in the Report CALC module. The output reports which are being filed reflect the correction of this error.

Additionally, enclosed is a hard copy of the North Carolina Utilities Commission's Order Adopting Forward-Looking Economic Cost Model and Inputs issued in Docket No. P-100, Sub 133b on April 20, 1998. The Order is also included on a 3.5" diskette labeled "N.C. FLEC Order" in WordPerfect 6.1.

Further, BellSouth filed a Motion for Reconsideration with the Commission on May 7, 1998, requesting that the Commission reconsider its decision on structure sharing. GTE filed a Motion for Reconsideration on May 14, 1998, requesting that the Commission reconsider its decisions on several issues including number of access lines, structure sharing, GTE's company-specific inputs, cost of capital, and depreciation rates. Carolina/Central also filed a Motion for Reconsideration requesting that the Commission reconsider its decision on structure sharing, distribution pairs per residential housing unit, and cable sizing factors. AT&T Communications of the Southern States, Inc. (AT&T) filed a Response to BellSouth's Revised BCPM 3.1 Cost Study. AT&T expressed concern over BellSouth's depreciation rates and the ILECs' structure sharing inputs. The Commission intends to handle AT&T's Response as a Motion for Reconsideration.

Based on the evidence of record in our proceeding, the inputs for which the four Motions for Reconsideration have been filed are significant and material issues. The Commission issued an Order on May 19, 1998 establishing a procedural schedule for comments and reply comments on the four Motions for Reconsideration and plans to make an expedited decision on such Motions. The Commission will inform you immediately of our decisions on said Motions which are anticipated to be made in late June.

Thank you for your consideration of the Commission's FLEC studies for BellSouth, Carolina/Central, and GTE.

Sincerely,

Jo Anne Sanford

Jo Anne Sanford, Chair

Enclosures: Ten 3.5" diskettes
Hard copy of Commission's Order Adopting FLEC Model and Inputs

cc: Sheryl Todd with ten 3.5" diskettes and hard copy of Commission's Order Adopting FLEC Model and Inputs
Geneva Thigpen with hard copy of text documents

**STATE OF NORTH CAROLINA**
**UTILITIES COMMISSION**
**RALEIGH**

DOCKET NO. P-100, SUB 133b

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

| | | |
|---|---|---|
| In the Matter of | | |
| Establishment of Universal Support | ) | ORDER ADOPTING |
| Mechanisms Pursuant to Section 254 | ) | FORWARD-LOOKING ECONOMIC |
| of the Telecommunications Act of 1996 | ) | COST MODEL AND INPUTS |

HEARD IN: Commission Hearing Room 2115, Dobbs Building, 430 North Salisbury Street, Raleigh, North Carolina, on Tuesday, February 3, 1998, Wednesday, February 4, 1998, Thursday, February 5, 1998, Friday, February 6, 1998, Monday, February 9, 1998, and Tuesday, February 10, 1998

BEFORE: Commissioner Allyson K. Duncan, Presiding, Chairman Jo Anne Sanford, and Commissioners Ralph A. Hunt, Judy Hunt, William R. Pittman, and J. Richard Conder

APPEARANCES:

For AT&T Communications of the Southern States, Inc.:

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Kenneth W. Lewis, Burford & Lewis, 719 W. Morgan Street, Raleigh, North Carolina 27603

Robin D. Dunson, AT&T Communications of the Southern States, Inc., 1200 Peachtree Street, N.W., Atlanta, Georgia 30309

Margaret C. Rhodes, Wilsie Adams, Stephen Ruscus, and Sanderson Hoe, McKenna & Cuneo, 1900 K Street, NW, Washington, D.C. 20006-1108

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For Business Telecom, Inc.:

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For GTE South Incorporated:

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For the North Carolina Cable Telecommunications Association:

Marcus W. Trathen, Wade H. Hargrove, Kathy Thornton, and David Kushner, Brooks, Pierce, McLendon, Humphrey & Leonard, Post Office Box 1800, Raleigh, North Carolina 27602

For North State Telephone Company:

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For Carolina Telephone and Telegraph Company and Central Telephone Company:

Dwight W. Allen, Vice President/External Affairs and General Counsel, and Robert Carl Voigt, Senior Attorney, Carolina Telephone and Telegraph Company and Central Telephone Company, 14111 Capital Boulevard, Wake Forest, North Carolina 27587-5900

For the Using and Consuming Public:

Antoinette R. Wike, Chief Counsel, and Robert B. Cauthen, Jr., Staff Attorney, Public Staff, Post Office Box 29520, Raleigh, North Carolina 27626-0520

Karen E. Long, Assistant Attorney General, North Carolina Department of Justice, Post Office Box 629, Raleigh, North Carolina 27602

BY THE COMMISSION: On May 8, 1997, the Federal Communications Commission (FCC) released a Report and Order in CC Docket No. 96-45 (Universal Service Order or USO) in response to Section 254 of the Telecommunications Act of 1996 (the Act). In this Order, the FCC asked the states to elect, by August 15, 1997, whether they would conduct their own forward-looking economic cost (FLEC) studies for the purpose of determining federal universal service support for nonrural eligible carriers' rural; insular, and high cost areas. In Paragraph 250 of the USO, the FCC prescribed the following ten criteria which a state-conducted study must meet in order to be approved for use in calculating federal universal service support:

1. The technology assumed in the study or model must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed. The model must include the incumbent local exchange companies' (ILECs') wire centers as the center of the loop network; the outside plant should terminate at the ILECs' current wire centers. The loop design should not impede the provision of advanced services. Wire center line counts should equal actual ILEC wire center line counts. Average loop length should reflect the ILECs' actual average loop length.

2. Any network function or element, such as loop, switching, transport, or signaling, necessary to produce supported services must have an associated cost.

3. Only long-run, forward-looking economic costs may be included. The long-run period must be long enough that all costs may be treated as variable and avoidable. The costs must not be the embedded cost of the facilities, functions, or elements. The study or model must be based on an examination of the current cost of purchasing facilities and equipment rather than list prices.

4. The rate of return must be either the authorized federal rate of return on interstate services, currently 11.25%, or the state's prescribed rate of return for intrastate services.

5. Economic lives and future net salvage percentages used in calculating depreciation expense must be within the FCC-authorized range.

6. The cost study or model must estimate the cost of providing service for all businesses and households within a geographic area, including the provision of multi-line business services, special access, private lines, and multiple residential lines.

7. A reasonable allocation of joint and common costs must be assigned to the cost of supported services.

8. The cost study or model and all underlying data, formulae, computations, and software associated with the model must be available to all interested parties for review and comment. All underlying data should be verifiable, engineering assumptions reasonable, and outputs plausible.

9. The cost study or model must include the capability to examine and modify the critical assumptions and engineering principles.

10. The cost study or model must deaverage support calculations to the wire center serving area level at least and, if feasible, to even smaller areas such as Census Block Group, Census Block, or grid cell.

The FCC also stated that the study must be the same study that is used by the state to determine intrastate universal service support levels pursuant to Section 254(f) of the Act.

On August 12, 1997, the Commission issued an Order electing to conduct its own FLEC study for submission to the FCC and notifying the FCC of its election. The Commission also adopted a timetable, which was modified by subsequent Orders, for developing North Carolina FLEC studies. The timetable included dates for filing proposed studies, supporting testimony and documentation, and for holding evidentiary hearings.

Proposed cost studies were filed by Carolina Telephone and Telegraph Company and Central Telephone Company (collectively, Carolina/Central), BellSouth Telecommunications, Inc. (BellSouth), and GTE South Incorporated (GTE), using Version 2.5/2.6 of the Benchmark Cost Proxy Model (BCPM); and by AT&T Communications of the Southern States, Inc. (AT&T) and MCI Telecommunications Corporation (MCI) jointly, using Release 4.0 of the Hatfield Model (HM). Carolina/Central and BellSouth updated their studies using BCPM 3.1, GTE updated its study using BCPM 3.0, and AT&T/MCI updated their study using HM 5.0.

The matter came on for hearing on February 3, 1998. AT&T and MCI jointly sponsored HM 5.0 and presented the direct and supplemental direct testimony of Don J. Wood and the rebuttal testimony of John C. Klick. AT&T also presented the direct and rebuttal testimony of Joseph Gillan; the direct, supplemental direct, and rebuttal testimony of James W. Wells, Jr.; and the rebuttal testimony of Art Lema. BellSouth and Carolina/Central jointly sponsored BCPM 3.1 and presented the direct, supplemental direct, and rebuttal testimony of Dr. Robert M. Bowman; the direct and supplemental direct testimony of Dr. Brian K. Staihr; and the direct and rebuttal testimony of Dr. Kevin Duffy-Deno. BellSouth also presented the direct testimony of Alphonso J. Varner and the direct and rebuttal testimony of D. Daonne Caldwell. Carolina/Central presented the direct and supplemental direct testimony of C. Steve Parrott and Marcus H. Potter. BellSouth presented the rebuttal testimony of Jamshed K. Madan, Michael D. Dirmeier, and David C. Newton (Georgetown Consulting Group). GTE presented the direct, supplemental direct, and rebuttal testimony of Dr. Mark S. Calnon and the direct, supplemental direct, and rebuttal testimony of Terence D. Robinson. GTE also presented the rebuttal testimony of Dr. Timothy J. Tardiff and Robert P. Cellupica. The Public Staff presented the revised testimony of John T. Garrison, Jr. The North Carolina Cable Telecommunications Association (NCCTA) presented the direct and rebuttal testimony of William J. Barta. Neither the Public Staff nor NCCTA sponsored a cost study.

The testimony of the following witnesses was entered into the record by stipulation: John I. Hirshleifer, direct and rebuttal (AT&T); Richard B. Lee, direct and rebuttal (AT&T); Dr. David L. Kaserman, direct (AT&T); G. David Cunningham, rebuttal (BellSouth); Dr. Randall S. Billingsley, rebuttal (BellSouth); Anthony J. Flesch, rebuttal (GTE); Gregory D. Jacobson, rebuttal (GTE); Jerome C. Weinert, rebuttal (Carolina/Central); John R. Hinton, direct (Public Staff); and Royster M. Tucker, III, direct (North State Telephone Company).

On February 27, 1998, the FCC released a Public Notice setting forth the information it needs to determine whether a state's cost study complies with the ten criteria prescribed in its Universal Service Order and the format in which this information should be presented.

Based on a careful consideration of the entire record in this matter, the Commission now makes the following

## FINDINGS OF FACT

1. It is appropriate to conduct separate cost studies to determine the forward-looking economic cost of providing universal service in the respective service territories of Carolina/Central, BellSouth, and GTE in North Carolina.

2. The BCPM 3.1 is the appropriate model to use in determining the forward-looking economic cost of providing universal service for Carolina/Central, BellSouth, and GTE in North Carolina.

3. Except as modified below, the user adjustable inputs and parameters proposed by Carolina/Central are appropriate for use in the FLEC study for their service territories.

4. Except as modified below, the user adjustable inputs and parameters proposed by BellSouth are appropriate for use in the FLEC study for its service territory.

5. The following user adjustable inputs and parameters for GTE's plant investment should be modified:

   a. Outside plant material and installation costs

   b. Support ratios

   c. Switching inputs

   d. Cable sizing factors

6. The following user adjustable inputs for GTE's expenses should be modified:

   a. Per line expenses: Network Support, General Support, Other Property Plant, Network Operations, Marketing, Services, Executive and Planning, and General and Administrative

   b. Percentage of investment expenses: Poles, Aerial Fiber Cable, Buried Fiber Cable

7. Expense inputs for Information Origination/Termination should be excluded from the FLEC studies of all three ILECs.

8. Structure sharing percentage inputs of each ILEC should be revised to reflect structure sharing percentages that fall midway between each ILEC's proposed percentages and the percentages proposed by AT&T/MCI as inputs into the HM 5.0.

9. The FLEC study inputs of each ILEC should include actual access line data for each wire center.

10. The prescribed cost of capital for intrastate services in North Carolina which is reasonable and appropriate for use in determining the forward-looking economic costs associated with providing universal service is 9.94%, based on the following capital structure and cost rates:

| Component | Ratio | Cost Rate | Weighted Cost Rate |
|---|---|---|---|
| Long-term debt | 42% | 7.38% | 3.10% |
| Common equity | 58% | 11.80% | 6.84% |
| Total | 100% | | 9.94% |

11. The appropriate economic lives and future net salvage percentages for calculating depreciation rates for use in the FLEC studies are those that are within the FCC-authorized range.

12. The appropriate input value for distribution pairs per residential housing unit for use in the FLEC studies is 1.4.

13. The appropriate tax rates and regulatory fee rate for use in the FLEC studies are as follows: federal income tax rate, 35%; state income tax rate, 6.9%; gross receipts tax rate, 3.22%; regulatory fee, 0.09%.

14. Revised FLEC studies conducted in accordance with the provisions and requirements of this Order will be in compliance with the FCC's ten criteria.

## DISCUSSION OF EVIDENCE AND CONCLUSIONS

## *PART NO. 1: OVERVIEW*

This proceeding was instituted to enable the Commission to adopt a FLEC study or studies acceptable to the FCC for the purpose of determining federal universal service support. The ILECs expressed concern that if the FCC bases its determination of federal support on costs that are not representative of costs in North Carolina (i.e., on costs that are understated), there will be an additional burden on the intrastate universal service fund.

It is anticipated that the ILECs, who are currently the universal service providers in their franchised areas, will be the principal recipients from the universal service fund. They have asserted that setting the cost too low will jeopardize service quality at affordable rates. The ILECs have sponsored company-specific studies using the BCPM which, they say, represent the reasonable forward-looking costs that an efficient provider of universal service would incur in their respective areas. The competitors, who will be contributors to the universal service fund, have asserted that setting the cost too high will thwart competition. AT&T and MCI have sponsored a study using the Hatfield Model which, they say, represents the costs that a least-cost, most-efficient provider would incur in providing universal service in a competitive environment.

The Commission has given substantial weight to testimony from ILEC witnesses regarding their companies' forward-looking costs. The Commission is persuaded, both by the evidence presented and by its own investigation, that the ILECs' networks employ efficient technology and good engineering practices. They also provide reliable service throughout the State. The Commission is therefore inclined to accept the ILECs' proposed user adjustable inputs where they are forward looking and reasonable. The question then becomes whether the Commission should also accept the ILECs' proposed model or whether another model would better accomplish our purpose.

## ***PART NO. 2: MODEL SELECTION***

### 2(a): MODEL SELECTION (CUSTOMER LOCATION / NETWORK DESIGN)

#### POSITIONS OF PARTIES

**BELLSOUTH:** The BCPM 3.1's road-based, customer-location methodology is superior to Hatfield 5.0's and, therefore, more accurately estimates the cost of providing universal service in North Carolina. In addition, the BCPM 3.1's network design is superior to HM 5.0's because it follows industry-accepted design standards; builds a network that reaches all customers — existing and potential; makes advanced services as available to rural customers as they are to urban customers; and builds a high quality network over which urban and rural North Carolinians can actually talk.

**CAROLINA/CENTRAL:** The BCPM 3.1 relies on the reasonable assumption that the great majority of customers, both business and residential, will be located along roads. In addition, the BCPM 3.1 more accurately estimates loop length, and accordingly provides an accurate and realistic estimate of loop cost (the most costly component of the serving network).

**GTE:** The BCPM platform provides a better basis for a universal service calculation than does the Hatfield Model. The BCPM's network architecture is developed by locating telephone plant along roads, streets, and avenues — where most customers can be

expected to live and where telecommunications facilities are currently placed. BCPM conforms to all applicable engineering and design standards, and its switching module reflects "actual ILEC switching purchases."

GTE has proposed that BCPM be chosen on an interim basis, and that it be populated with GTE company-specific inputs. GTE's cost model (Integrated Cost Model or ICM) has been filed with the Commission in Docket No. P-100, Sub 133d, relating to the pricing of unbundled network elements (UNEs), but ICM could not be modified for universal service purposes in time for consideration here. GTE indicates that work on ICM for universal service continues, and that it intends to submit ICM to the Commission at a later date.

**AT&T:** The Hatfield Model is more accurate than the BCPM in locating customers and estimating the costs of building a network to them. Hatfield 5.0 locates the customers (many within 50 feet of their actual location) and uses modeling assumptions that result in the use of the least-cost material and equipment required to engineer a high quality network. Where data is available — for approximately 70-75% of customers — the Hatfield Model uses the actual location of the customer. The remaining customers are included at the census block level. In addition, the Hatfield Model develops costs based on the total demand for network elements, including loops, switching, and interoffice transport. By designing a forward-looking network based on total demand, the Hatfield Model properly includes economies of scale.

**MCI:** The Hatfield 5.0 is superior to BCPM 3.1 for purposes of customer location. While geocoding is currently not available for all customers, it does provide locations for 64% of the customers in North Carolina, and the ability to geocode addresses will only improve in the future.

**NCCTA:** The NCCTA believes that either of the basic platforms of the Hatfield and BCPM models will serve the purposes for which they are intended and that either model could be recommended to the FCC consistent with the FCC's requirements.

**ATTORNEY GENERAL:** The differences between BCPM 3.1 and Hatfield 5.0 appear de minimis, and either the BCPM or the Hatfield Model would be acceptable to use in this docket if the input values provided to the models are cost appropriate. By the evidence presented in this docket, Hatfield 5.0 does not appear to calculate significantly different route miles from the route miles calculated by the BCPM which does not use geocoding.

**PUBLIC STAFF:** The BCPM 3.1 is more reasonable, more accessible, and more appropriate than the Hatfield Model for determining the forward-looking economic cost of providing universal service in North Carolina. The BCPM method of locating customers is more appropriate than the Hatfield method for FLEC study purposes. Once the Hatfield

Model establishes clusters based on geocoded data, it disregards the data when it places customers throughout the clusters and actually models the facilities.

## MAJOR DIFFERENCES BETWEEN BCPM AND HATFIELD

The major differences in the model platforms appear to be in the areas of customer location and network design. A more detailed description of each of these areas, based on the positions of the proponents of each model, follows.

### A. CUSTOMER LOCATION:

#### BCPM

According to the proponents of the BCPM model, the BCPM 3.1 relies on publicly available wire center boundary data obtained from Business Location Research (BLR). A BCPM 3.1 customer location algorithm then partitions the area of a wire center into "microgrids," roughly 1,500 feet by 1,700 feet in size (0.09 square miles). Thus, each Census Block within the serving wire center is overlaid with microgrids, unless the entire Census Block falls within a single microgrid.

In the rural areas of the wire center, the allocation of customer locations is based upon the road network, the location of which is known in every Census Block. Proponents of the BCPM model state that the BCPM 3.1 uses data on the road network obtained from TIGER/Line files (Topologically Integrated Geographic Encoding and Referencing) from the U.S. Census Bureau. In dense urban areas, Census Blocks may be smaller than the microgrid, and the assignment of customer data along the road network is not required. Because the Census Block road network is known with certainty and because people tend to live along roads, proponents of the BCPM model state that the BCPM 3.1 apportions Census Block housing units to microgrids based on the share of the Census Block's road mileage that occurs in a given microgrid.

These microgrids are then aggregated into telephone engineering Carrier Service Areas (CSAs) and Distribution Areas (DAs) as appropriate. These are referred to as "ultimate grids." The maximum size of an ultimate grid is constrained to approximately 12,000 feet by 14,000 feet (roughly six square miles) to comport with engineering guidelines. BCPM proponents state the BCPM 3.1 does not assume that customers are uniformly distributed within each ultimate grid. Rather, each ultimate grid is divided into four distribution quadrants, each of which may contain a distribution area. The latitude and longitude coordinates of the distribution quadrants are determined by first establishing the road centroid of the ultimate grid. The distribution quadrants are centered on this road centroid. For those distribution quadrants that do not have any customers assigned to them, no distribution area is designed within the distribution quadrants, thus ensuring that plant is not "built" in nonpopulated areas.

**HATFIELD**

Proponents of the Hatfield Model contended that the Hatfield 5.0 is at least as accurate as the BCPM for locating one-third of North Carolina consumers and more accurate than the BCPM in locating two-thirds of consumers. The proponents of the Hatfield Model further stated that the Hatfield 5.0 accurately locates customers (precisely locating a large percentage of all households to within fifty feet of actual locations), identifies clusters of households as real-world neighborhoods or groupings, and builds a network to these neighborhoods using the same engineering practices, efficiencies, and technologies available to network designers in the real world. In order to accomplish this task, Hatfield 5.0 uses a process known as "geocoding." Simply defined, "geocoding" means matching customers with their addresses and locating those addresses by latitude and longitude.

The Hatfield proponents further explained that the geocoding process is performed by a company called PNR Associates (PNR) which makes use of mailing lists from Metromail, a mass mailing firm, employed by many businesses for advertising purposes. PNR also obtains business addresses from Dun and Bradstreet. PNR then goes to the U.S. Geological Survey TIGER database to determine the latitude and longitude of the street addresses. At that point, PNR uses a mathematical formula to determine where people are "clustered" or, in other words, where the towns and neighborhoods are located. For modeling purposes, a rectangle is overlaid over the cluster, and this defines the serving area. Customers are then assigned to a wire center.

Proponents of the Hatfield Model state that the Hatfield 5.0 assumes that customer locations for which geocoding data currently does not exist are distributed evenly along the perimeter of the Census Block. The Proponents of the Hatfield 5.0 believe that this is an appropriate assumption because: (1) Census Blocks often are bounded by roads, and (2) placing customers at the outer limits of the Census Blocks is a conservative approach which tends to overstate required distribution plant. Therefore, even though the amount of plant required may be slightly overstated, there will be enough plant to ensure that the network will reach all of the customers.

**B. NETWORK DESIGN:**

**BCPM**

The proponents of the BCPM explained that the great majority of the costs of providing universal service are the costs of constructing and maintaining the loop network. The loop network consists of the facilities from the central office switching center to the customer's premise. The loop includes feeder cable, distribution cable, Feeder Distribution Interfaces (FDIs), distribution terminals, drop wire, and a Network Interface Device (NID) at the customer's premise. The facilities between the switching center and

the terminal at the customer's premise are typically divided into feeder and distribution cable plant. Feeder facilities are the facilities between the switching center and the FDI. A FDI is generally the demarcation point between feeder and distribution facilities. Distribution facilities begin at the FDI and end at the NID or at a building terminal. A distribution terminal (drop terminal) is used to terminate drop wire and connect the drop wire to the distribution cable. Drop wire connects the distribution cable to the network device located at the customer's premises. A sound cost proxy model must design a network that includes all the loop cost elements necessarily incurred in providing customers with the capability of placing and receiving telephone calls. BellSouth and Carolina/Central witness Bowman referenced AT&T's Outside Plant Engineering Handbook (August 1994) which generally limits copper loops beyond the Digital Loop Carrier Remote Terminal (DLC) to 12,000 feet for quality service. Witness Bowman stated that the BCPM 3.1 followed this engineering practice in its network design by using larger 24-gauge cable beyond 11,100 feet and replacing standard channel unit cards with extended range line cards beyond 13,600 feet.

Witness Bowman stated that the use of these standard channel unit cards, combined with the distance of the loop past the DLC, results in an unacceptable decibel loss on the loop. To provide an adequate grade of service using standard channel unit cards, the maximum copper loop length from the DLC to the customer for buried cable should not exceed 12,000 feet of 26-gauge cable and 14,800 feet of 24-gauge cable. If aerial plant is used, the decibel loss increases and, therefore, the maximum copper loop lengths would be less than 12,000 feet on 26-gauge cable and less than 14,800 feet on 24-gauge cable.

Proponents of the BCPM 3.1 explained that it builds to all housing units, regardless of whether they are occupied or currently have phone service. BCPM proponents contended that as the carrier of last resort, the incumbent local exchange company must stand ready to serve all housing units.

**HATFIELD**

The proponents of the Hatfield Model explained that it designs facilities to neighborhoods the way an engineer would design these facilities. After customers are located, the Hatfield 5.0 identifies customers that can be served together logically, such as customers located in the same neighborhood or town, subject to any technological constraints. The model builds feeder facilities to these locations and defines carrier serving areas, where possible, to include the identified groupings. Within each neighborhood, Hatfield 5.0 designs distribution facilities using the efficient rectangular lots favored by real-world real estate developers. For outlying customers served by roads, Hatfield 5.0 actually builds the distribution along the roads to serve the customers.

The proponents of the Hatfield Model stated that it utilizes the same least cost, most-efficient technologies that ILECs currently are deploying, including next generation digital loop carrier systems, digital switching, fiber rings for interoffice transport, and signaling system 7. For parts of the network in which the choice of efficient technologies may be different under different conditions, the model contains alternative solutions and chooses efficient technologies the way real engineers make choices. For example, one choice an engineer must make in designing a telephone network is how much copper versus fiber feeder to use. Copper, being a semi-precious metal, is expensive while fiber is relatively cheap. However, fiber feeder requires installation of expensive DLC equipment. Therefore, while it is not cost effective to use fiber feeder for short distances, at some point it becomes less costly to use fiber with the DLC electronics rather than the expensive copper. Proponents of the Hatfield Model stated that in order to determine the most cost effective solution, Hatfield 5.0 compares costs of copper and fiber for every feeder loop segment and chooses the most efficient alternative.

Proponents of the Hatfield Model contended that the universal service network which the Hatfield Model designs is fully capable of accommodating the next generation of advanced services, including low cost, high speed digital subscriber line services expected to be available later this year. The Hatfield Model makes these capabilities available, in part, by the modeling of T-1 technologies in place of coarse-gauge cable and load coils utilized in embedded networks to permit extended copper loop lengths. Thus, even the longest loops (those over 18,000 feet) can accommodate advanced services including Integrated Services Digital Network (ISDN) and other high speed data applications. The Hatfield Model proponents stated that, further, Hatfield 5.0 conducts tests of the outside plant facilities that it models to ensure that the transmission parameters necessary to permit accommodation of advanced services are not exceeded.

Hatfield Model proponents stated that the Hatfield 5.0 develops costs based on the total demand for network elements, including loops, switching, and interoffice transport. Total demand includes the demand created by residence (first and additional lines), business (single and multi-line), public (coin), and special access services. Hatfield 5.0 builds only to customers that currently have telephone service. The proponents of the HM argued that universal service support should not include the potential cost of serving customers that currently do not have service.

## DISCUSSION

As noted above, two cost proxy models have been presented to the Commission for consideration, as well as various sets of cost inputs to those models. The BCPM sponsored by Carolina/Central and BellSouth (and adopted by GTE on an interim basis) is a model that has been developed by BellSouth, INDETEC International, Sprint, and US West. The Hatfield Model has been developed by HAI Consulting, Inc., for AT&T and MCI.

The BCPM bases its customer location on the assumption that households and businesses typically are located near roads and centering the distribution quadrant of the DA at the center of the roads establishes network facilities closer to where customers are located. The Hatfield Model uses geocoding which means matching customers with their addresses and locating those addresses by latitude and longitude. The location of customers will then determine the cost of cable, switches, and other facilities necessary to implement a least cost, forward-looking network.

The BCPM 3.1 network was designed by using large 24-gauge cable beyond 11,100 feet and replacing standard channel unit cards with extended range line cards beyond 13,600 feet. The Hatfield 5.0 models with T-1 technologies in place of coarse-gauge cable and load coils utilized in embedded networks to permit extended copper loop lengths. Thus, even the longest loops (those over 18,000 feet) can accommodate advanced services including ISDN and other high speed data applications.

In reviewing the cost model selection issue, the Commission notes that neither the Attorney General nor the NCCTA recommended one model over the other in their Briefs, but seemed to agree that either of the models may be acceptable. The Attorney General indicated that evidence before the Commission supports the opinions of the witnesses that the models are converging. The Attorney General also mentioned that when BellSouth's panel of Georgetown Consulting witnesses Madan, Dirmeier, and Newton fed BellSouth-derived inputs into the Hatfield Model, they got results very similar to those obtained by BellSouth's BCPM. Similarly, when AT&T/MCI witness Klick compared the cabling that each model calculated, the total route miles were very close (41,398 total route miles for Hatfield 5.0; 42,822 total route miles for BCPM 3.1, a difference of about 3%). The NCCTA commented that, driven by FCC-mandated criteria and FCC-sponsored technical discussions, it appears that the model platforms are becoming more similar and one would expect that, over time, the platform distinctions will become even less significant.

In its Proposed Order, the Public Staff endorsed adoption of the BCPM 3.1 rather than the Hatfield Model, asserting that BCPM 3.1 is more reasonable, more accessible, and more appropriate for use in determining the forward-looking economic cost of providing universal service in North Carolina. In arriving at its recommendation, the Public Staff discussed the strengths and weaknesses of both models.

Customer location is unquestionably an important part of the modeling process, and the Commission agrees with the Public Staff's analysis on the following points regarding the value of geocoding as it currently exists in the Hatfield Model. For instance, the Public Staff stated that, first of all, geocoding is only as accurate as the underlying addresses. Not only is it possible that some street addresses are inaccurate, it is a fact that other addresses are not street addresses at all. The Public Staff pointed out that, according to witness Wood's testimony, only about two-thirds of customers in North Carolina are

geocodable, and the most geocodable locations are in suburban areas. Other areas tend to be difficult to geocode because of the presence of post office boxes in urban areas and rural route numbers in rural areas. The Public Staff further noted that BellSouth and Carolina/Central witness Duffy-Deno pointed out that little is likely to be gained in terms of cost estimation from geocoding in urban areas, while accurate location in rural areas is critical. Thus, whatever the virtues of geocoding, they fail to manifest themselves where they are needed most. The Public Staff stated that it believes the BCPM method of locating customers is more appropriate than the Hatfield method for FLEC study purposes. The Public Staff stated that this conclusion is bolstered by the fact that, once the Hatfield Model establishes clusters based on geocoded data, it disregards the data when it places customers throughout the clusters and actually models the facilities. The Public Staff agreed with witness Duffy-Deno's testimony that "a sound cost proxy model should reasonably reflect the locations of customers, especially in rural high cost areas . . . [and] should reasonably reflect the telecommunications structures and facilities needed to serve customers in their locations."

The Public Staff further noted that there was considerable debate over the use of extended range line cards and how much power loss occurs over copper facilities. The BCPM developers believe that good engineering design limits the length of copper beyond the DLC to 12,000 feet, and that after 13,000 feet an extended range line card should be used. The Hatfield developers take a different approach, assuming that a copper loop will work out to 17,600 feet before an extended range line card is needed. The Public Staff noted that it is not clear whether costs for those line cards have been included in the model and, if not, whether they would drive the overall loop cost above that produced by the BCPM.

In its Proposed Order, the Public Staff also noted that the models build to different numbers of housing units; Hatfield to current customers and BCPM to all housing units. The Hatfield proponents, the competing local providers (CLPs), maintain that universal service funding should be based only on the cost of serving customers who have telephones. BCPM proponents, the ILECs, point out that as carriers of last resort they have the obligation to serve all who apply for service. Here again, the Commission agrees with the Public Staff that the BCPM assumption is correct and that a forward-looking cost study should include all housing units.

The Commission believes that both models have considerable merit, with each having strengths and weaknesses. However, the Commission believes that the arguments advanced by the Public Staff tip the balance in favor of the BCPM. In particular, the Commission has concerns regarding the geocoding method used by the Hatfield Model 5.0 and believes that the customer location methodology used by the BCPM is more appropriate and better suited to the rural areas of North Carolina where it would be expected that many of the high cost areas are located.

## CONCLUSIONS

The Commission concludes that the BCPM 3.1 is more reasonable, more accessible, and more appropriate than the Hatfield Model for determining the forward-looking economic cost of providing universal service in North Carolina. The Commission further concludes that the Carolina/Central version of the BCPM 3.1, which is the only version that is capable of producing results below the wire center level, should be used by BellSouth, GTE, and Carolina/Central in determining the forward-looking economic cost of providing universal service in North Carolina.

## 2(b): DATA VERIFICATION / PREPROCESSING INFORMATION

## POSITIONS OF PARTIES

**BELLSOUTH:** Citing FCC Criterion No. 8 that models should be open and verifiable, BellSouth argued that the Commission lacks meaningful access to the preprocessing information embedded in HM 5.0, especially that information related to clusters and clustering algorithms. PNR apparently considers geocoded locations to be proprietary; and even if geocoded information and clustering algorithms could be obtained, the annual licensing cost is approximately $2.6 million. Thus, HM 5.0 cannot be adequately verified.

**CAROLINA/CENTRAL:** Carolina/Central did not address this specific issue in their Brief or Proposed Order.

**GTE:** GTE echoed the position of BellSouth, stressing that the geocoding data was deemed proprietary to PNR's data vendors, was derived from 12 different databases and five independent models or algorithms, and costs $2.6 million annually.

**AT&T:** AT&T did not address this specific issue in its Brief or Proposed Order.

**MCI:** MCI contended that, while both models contain preprocessing information that has not been made completely available, HM 5.0 provides more readily available information than BCPM 3.1. Furthermore, the Commission can verify the information involved in the HM 5.0 preprocessing aspect of customer location through a request to Hatfield proponents or to PNR. There should be no cost for that type of demonstration. The licensing and user fees are to obtain the underlying database and all the software that goes along with the Metromail database. The $2.6 million figure is for nationwide geocoding information as well as training. MCI also pointed out that BCPM proponents had not provided all the missing utility header and functions necessary to run the BCPM preprocessor and that BCPM 3.1 has feeder and subfeeder calculations in the processor that cannot be evaluated.

**NCCTA:** The NCCTA did not address this specific issue in its Brief.

**ATTORNEY GENERAL:** The Attorney General did not address this specific issue in his Brief.

**PUBLIC STAFF:** The Public Staff did not address this specific issue. However, the Public Staff stated that BCPM 3.1 complies with the FCC's ten criteria, with the possible exception of the first one.

## DISCUSSION

FCC Criterion No. 8 reads:

> "The cost study or model and all underlying data, formulae, computations, and software associated with the model must be available to all interested parties for review and comment. All underlying data should be verifiable, engineering assumptions reasonable, and outputs plausible."

The size and complexity of HM 5.0 and BCPM 3.1 are such that an exhaustive assessment of their openness and verifiability is likely to be problematical. Although BellSouth and GTE have raised some legitimate concerns, MCI has pointed out that preprocessing assumptions are common to both models and that the Commission would have access to verification of the preprocessing aspect of customer location through a request to Hatfield proponents or PNR at no cost. In any event, MCI also pointed out that the $2.6 million figure was a comprehensive nationwide figure. Thus, both models appear to be reasonably open and verifiable.

## CONCLUSIONS

The Commission concludes that both HM 5.0 and BCPM 3.1 satisfy FCC Criterion No. 8.

# ***PART NO. 3: INPUTS***

## 3(a): DEFAULT INPUTS / CURRENT AND HISTORICAL COSTS / IMPACT OF COMPETITION

## POSITIONS OF PARTIES

**BELLSOUTH:** BellSouth's inputs to BCPM 3.1 reflect the costs of currently available technologies. BellSouth's inputs do not reflect embedded costs.

**CAROLINA/CENTRAL:** Although historical costs should not be considered determinative of the issue, an ILEC's current costs provide the best information available as a starting point in estimating costs on a go-forward basis.

**GTE:** GTE contended that the methodology used in the Best of Breed survey to develop BCPM's default input values is far superior to the "pick and choose" approach of Hatfield 5.0. GTE contended that its specific categories of inputs for cost of capital, depreciation lives, structure sharing, structure mix and fill factors and GTE's ARMIS data are far superior to the default inputs in HM 5.0, and are also better than BCPM's default inputs because they are GTE specific.

**AT&T:** Hatfield 5.0 inputs adjusted for North Carolina should be used rather than company-specific inputs. The inputs sponsored by BellSouth, GTE, and Carolina/Central in this proceeding fail to address the impact of competition on the local exchange market and represent embedded costs rather than the cost an efficient provider would expect to incur.

**MCI:** Hatfield 5.0 inputs are the appropriate inputs for use in the cost proxy models submitted to the FCC. Hatfield 5.0 is designed to accurately estimate the cost an efficient carrier would incur to provide service in the geographic area being studied.

**NCCTA:** The sponsors of both models have failed to substantiate the basis of their inputs to the models and have failed to validate their model results through real-world comparisons. In many instances, the use of company-specific inputs is the best way to approximate the forward-looking costs of constructing a network. However, the use of existing cost information is inherently a backward-looking approach and, therefore, carries with it the danger that inappropriate (i.e., embedded or nonforward looking) costs will be utilized.

**ATTORNEY GENERAL:** The Attorney General recommended that the Commission require the BCPM proponents to submit model results using the BCPM defaults as inputs and compare those results with the Hatfield results and the company-specific results already submitted in this docket. The Attorney General recommended that the Commission then choose specific inputs that are cost appropriate in each case, confident that such cost appropriate inputs will fall somewhere between the input values advocated by the proponents of the two models.

**PUBLIC STAFF:** The ILECs' networks employ efficient technology and good engineering practices. The Commission should accept the ILECs' proposed user adjustable inputs where they are forward looking and reasonable. The Public Staff recommended modifications in some proposed ILEC inputs where it found that they were not forward looking and reasonable.

## DISCUSSION

The Commission's goal is to determine inputs that would accurately reflect long-run, forward-looking economic costs, as required by the FCC. Either method of determining these costs, using current costs as the base, as proposed by BellSouth and Carolina/Central, or default values based on fresh estimates of the costs of network construction and operation, can be superior, depending on the care with which each is developed. The proposals of BellSouth and Carolina/Central deserve careful consideration because they represent verifiable and current costs of well-engineered networks that have provided a high quality of service. Examining current costs is certainly a reasonable first step in determining forward-looking costs. AT&T and MCI, however, pointed out plausible reasons why these proposed costs might be too high, given changes in the industry. First, ILECs have plans to become more efficient. These efficiency improvements are not reflected in the cost inputs, according to AT&T and MCI. Second, competition can be expected to spur additional innovation, efficiency improvements, and cost cutting not currently reflected in the proposals filed by the ILECs. While these are plausible scenarios, their true impact is speculative and thus demands that a very secure foundation of cause, mechanism, and potential effect be put in place. AT&T and MCI have not put in place a sufficient foundation for the Commission to accept their proposals. The Public Staff recommended the acceptance of the ILECs' proposed user adjustable inputs where they are forward-looking and reasonable. The Public Staff has also recommended adjustments to some costs proposed by the ILECs, and these recommendations are discussed under other issues.

## CONCLUSIONS

The Commission concludes that company-specific inputs, where they are forward looking and reasonable, should be used in lieu of default values.

## 3(b): EXPENSE INPUTS

## POSITIONS OF PARTIES

**BELLSOUTH:** The expense inputs used in BellSouth's exhibit are correct.

**CAROLINA/CENTRAL:** The expense inputs used in Carolina/Central's exhibit are correct.

**GTE:** The expense inputs used in GTE's exhibit are correct.

**AT&T:** Inputs should represent the Commission's best judgment as to the forward-looking costs of the most efficient technology that could be used to interconnect customers with existing wire center locations.

**MCI:** Hatfield 5.0 inputs are the appropriate inputs for use in the cost proxy models submitted to the FCC.

**NCCTA:** The NCCTA did not address the adjustments proposed by the Public Staff with specificity in its Brief. NCCTA did state that it is not clear whether the BCPM's estimate of operating expenses allegedly required to support universal service includes categories of expenses that are incurred mainly to provide competitive and/or discretionary services.

**ATTORNEY GENERAL:** The Attorney General addressed expense inputs in general in his Brief, but did not discuss the Public Staff's proposed adjustments with specificity.

**PUBLIC STAFF:** In its Proposed Order, the Public Staff recommended certain adjustments to expense inputs. More specifically, the Public Staff recommended that expense inputs for Information Origination/Termination should be excluded from the FLEC studies of all three ILECs and that the following user adjustable inputs for GTE's expenses should be modified:

a. Per line expenses: Network Support, General Support, Other Property Plant, Network Operations, Marketing, Services, Executive and Planning, and General and Administrative.

b. Percentage of investment expenses: Poles, Aerial Fiber Cable, and Buried Fiber Cable.

## DISCUSSION

The BCPM uses inputs for determining operating expenses on either a per line basis or as a percentage of the investment for the related expense. In some cases, the BCPM permits the use of either type of input for a particular expense. The per line expense inputs for all three ILECs include amounts for expenses recorded in Account 6310 (Information Origination/Termination) of the Uniform System of Accounts (USOA). The BCPM, however, does not include any investment associated with these expenses. Part 32 of the FCC's rules defines the amounts to be recorded in Account 6310 as expenses associated with investments in station apparatus, large private branch exchanges, public telephone terminal equipment, and other terminal equipment. The Commission agrees with the Public Staff that these are not investments or expenses that should be included as universal service costs.

The remaining adjustments, as proposed by the Public Staff, concern only GTE.

The record shows that GTE's proposed per line expenses are typically higher than the expenses proposed by either BellSouth or Carolina/Central. GTE's per line amounts are based on a calculation of the universal service expense associated with its 1996 expenses. These amounts are then divided by the number of access lines to obtain the desired per line expense amount. GTE's workpapers indicate that it used 321,139 access lines to calculate expenses on a per line basis. However, according to its 1996 Annual Report, GTE had 366,794 access lines in service in North Carolina. The Commission agrees with the Public Staff that GTE's proposed per line expenses are overstated and should be adjusted to reflect the higher number of access lines.

In addition, the Commission concurs with the position taken by the Public Staff that the per line amount for GTE's General Support expense should be adjusted to reflect the change in investment support associated with the account discussed above. This adjustment is accomplished by a pro rata reduction in the expense associated with Furniture and Office Equipment investments.

Another adjustment recommended by the Public Staff, which the Commission finds to be necessary, reasonable and appropriate, concerns Services expenses attributable to universal service. GTE has proposed a per line amount of $2.44 compared to BellSouth's $0.46 and Carolina/Central's $0.73. GTE's workpapers indicate that a 73.4% factor was used but failed to state a basis for this factor. The workpapers filed by BellSouth indicate that an allocation factor of 11.78% was used based on the allocation of common line costs to this expense. Since the Services expenses per access line according to the Annual Reports filed by BellSouth, GTE, and Carolina/Central for the years 1994 through 1996 are relatively equal, it appears that the difference in the per line expense amounts is attributable to the discrepancy in the allocation factors. The Commission agrees with the Public Staff that the 73.4% factor used by GTE represents an unreasonably high allocation of Services expenses to universal service. Therefore, given the similarities between the operating conditions of GTE and Carolina/Central, the Commission concludes that the per line expense amount used by Carolina/Central is a reasonable amount for use in GTE's service area.

With respect to the expense percentage of investment inputs, the Commission concurs with the position taken by the Public Staff that three of the inputs proposed by GTE reflect unreasonable assumptions. First, the Poles expense reflecting 9.07% of the Poles investment is unusually large compared to GTE's historical Poles expense, which, according to its Annual Reports ranged from 1.10% to 2.20% of the associated poles investment. Thus, the Commission believes that the Poles expense amount used by Carolina/Central represents a more reasonable amount of Poles expense for GTE.

The other two inputs for GTE that the Public Staff argued should be adjusted concern the Aerial Fiber Cable and Buried Fiber Cable expense inputs. Unlike BellSouth and Carolina/Central, GTE did not differentiate between copper and fiber cable expenses.

BellSouth and Carolina/Central, however, proposed much lower expense factors for fiber cable than for copper cable. GTE's existing Aerial Cable and Buried Cable consists mostly of copper, according to its 1996 Annual Report. The overall Aerial Cable and Buried Cable expense factors therefore appear to be appropriate for copper cable, while overstating the expense cost associated with fiber cable. Because of the operating similarities between GTE and Carolina/Central, the Commission agrees with the Public Staff that the relationship between Carolina/Central's copper and fiber cable expenses provides a reasonable method for adjusting GTE's fiber cable expenses. Thus, GTE's Aerial Fiber Cable expense input should be adjusted to reflect the same relationship with GTE's Aerial Copper Cable that exists between Carolina/Central's Aerial Fiber Cable and its Aerial Copper Cable. Likewise, GTE's Buried Fiber Cable expense input should be adjusted to reflect the same relationship with GTE's Buried Copper Cable that exists between Carolina/Central's Buried Fiber Cable and its Buried Copper Cable.

## CONCLUSIONS

The Commission concludes that, for the reasons set forth above, the expense input adjustments proposed by the Public Staff are reasonable and appropriate and that BellSouth, GTE, and Carolina/Central should make the appropriate revisions to their cost studies.

## 3(c): WIRE CENTER LINE COUNTS

## POSITIONS OF PARTIES

**BELLSOUTH:** BellSouth filed its Proposed Order, Brief, and three Attachments on March 10, 1998. In Attachment 3, BellSouth presented its updated BCPM output to reflect that the number of lines by wire center have been adjusted to match the 4044 report (station development report), which is filed monthly with the Commission, based upon recommendations from the Public Staff.

**CAROLINA/CENTRAL:** Carolina/Central's FLEC study reflected the actual line count for each wire center. During cross-examination, Public Staff witness Garrison testified that he had found some errors in the line counts, but he agreed that Carolina/Central's revised data files on the actual access line inputs appear to be correct.

**GTE:** GTE did not address this issue with specificity in its Proposed Order or Brief.

**AT&T:** AT&T did not address this issue with specificity in its Proposed Order or Brief.

**MCI:** MCI stated that line counts at the wire center are estimated by HM 5.0 based on demographic data. The current release of the model has the capability to normalize